alphabetical index to vernacular and their corresponding scientific names. The three islands represent an area of 860 square kilometers, or about 332 square miles, and possess a flora of 394 species distributed among 80 families from Polypodiaceae to Compositae. Those families predominating, as shown by the number of species recorded, are Leguminosae (41), Gramineae (35), Convovulaceae (25), Euphorbiaceae (24), Cyperaceae (23), and Compositae (20). One new species is described in each of the following genera: *Schizachyrium*, *Ficus*, *Pisonia*, *Kallstroemia*, *Bursera*, *Phyllanthus*, *Croton*, *Maytenus*, *Condalea*, *Casearia*, and *Melampodium*.—J. M. GREENMAN.

Applied botany.—KRAEMER[4] has accomplished a very laborious task for the benefit of students in technical schools, pharmaceutical and medical colleges, food analysists, etc. Although emphasizing the technical side of plants, he has included a basis of morphology and physiology, which should put the student, interested chiefly in the commercial aspect of plants, in touch with the scientific aspect. The seven chapters include the following subjects: Principal groups of plants, under which is given an outline of the plant kingdom; Cell contents and forms of cells; Outer and inner morphology of the higher plants; Botanical nomenclature, which is also a glossary of technical terms; Classification of angiosperms yielding economic products; Classification of medicinal plants; and Microscopic technique of reagents.

The book is a thesaurus of information, and as a book of reference should be of great service to botanists in general.—J.M.C.

North American flora.—The first part of volume 34 presents 50 genera of the Helenieae, all but 2 of them by RYDBERG.[5] The new genera proposed are *Nesothamnus* (type species, *Perityle incana*), *Leptopharynx* (type species, *Perityle Parryi*), *Pappothrix* (type species, *Laphamia rupestris*), *Amauriopsis* (type species, *Amauria dissecta*), *Cephalobembix* (type species, *Schkuhria neomexicana*), *Trichymenia* (type species, *Hymenothrix Wrightii*). New species are described also in *Venegazia*, *Psilostrophe* (3), *Baileya* (3), *Perityle* (5), *Laphamia* (2), *Loxothysanus*, *Bahia* (2), *Hulsea* (3), *Tetracarpum* (2), *Hymenopappus* (5), *Othake* (2), *Rigiopappus*, and *Chaenactis* (3).—J. M. C.

NOTES FOR STUDENTS

Toxic effects.—The observation that small traces of salicylic acid (o-oxybenzoic acid) in the presence of comparatively large quantitites of p-oxybenzoic acid have a deleterious effect on the growth of *Penicillium*, while both p-oxybenzoic and m-oxybenzoic acids serve as food, has led BOESEKEN and

[4] KRAEMER, HENRY, Applied and economic botany. 8vo. vi+806. *figs. 424*. Philadelphia (145 N. 10th St.): Published by the author. 1914. $5.00.

[5] North American Flora **34**: part 1. pp. 80. Carduaceae (Helenieae), by P. A. RYDBERG; *Baeria* and *Lasthenia*, by H. M. HALL. New York Botanical Garden, 1914.

WATERMAN[6] to investigate the behavior of these acids and numerous other compounds with reference to their toxic action and to their nutritive value. The substances investigated cover a wide range, including acids, alcohols, and chlorine and bromine derivatives of the hydrocarbons of the aliphatic series, and acids and their oxygen derivatives, phenols, and hydrocarbons of the carbocylic series. The work is not well organized, and the results lack quantitative value. The extent of growth of the fungus in the different solutions is indicated by + and −. The ranges of concentrations of the substances used are not sufficiently wide to permit the determination of inhibiting concentrations with any degree of exactness. Moreover, the concentrations used are entirely arbitrary and without reference to chemical properties of the substances. In some cases of slightly soluble substances (the higher fatty acids) the concentrations were not known. Some of the results appear unusual. It is known that the various species of blue molds are not particularly selective as to their food. It is surprising, nevertheless, to note that such substances as chloroform, carbon-tetrachloride, dichlor-brom-ethylene, and benzene are said to serve as nutrients for these molds. The question occurs whether the belated growth in flasks containing these somewhat volatile substances was anything more than the film of growth formed by *Penicillium* even on the surface of inert solutions to which no organic nutrients have been intentionally added. The authors believe that a general parallelism exists between the relative toxicity of the various substances and their partition coefficient in oil and water. They find, therefore, a satisfactory explanation of the different behavior of the substances in the theories of MEYER and OVERTON, both of which, it should be stated, however, were formulated with reference to chemically inert substances or, at most, very weakly basic organic substances (OVERTON).

The conclusions reached by the authors may be summed up as follows. In general, substances act as food or poison according to the magnitude of their partition coefficients in oil and water, those relatively very soluble in oil being highly toxic, and those with a low partition coefficient serving as food. Some substances (cetyl alcohol, higher fatty acids, napthalene) very soluble in oil but only slightly soluble in water serve as food, and by reason of their slight

---

[6] BOESEKEN, J., and WATERMAN, H., Over een biochemische methode ter bepaling van kleine haeveelheden salicylzuur naast een overmaot p-oxy benzoëzuur. Konink. Akad. Wetensch. Amst. **20**^{1}:548–552. 1911.

———, Over de werking van eenige benzolderivaten op de ontwikkeling van *Penicillium glaucum*. *Ibid.* 552–567. 1911.

———, Over de werking van eenige koolstofderivaten op de ontwikkeling van *Penicillium glaucum* en hunne remmende werking in verband met oplosbaarheid in water en in olie. *Ibid.* **20**^{2}:965–973. 1912.

———, Werking van in water gemakkelijk, in olie niet oplosbare stoffen op den groei van den *Penicillium glaucum*. *Ibid.* 1246–1251. 1912.

solubility in water are not toxic. Substances easily soluble in water act either as poisons or as nutrients according to their relatively higher or lower solubility in oil. Substances easily soluble in water and slightly soluble in oil act as nutrients, but not as poisons. In other cases, where this theory fails to explain the toxicity of substances, as with some dibasic acids easily soluble in water and scarcely soluble in oil, which nevertheless are toxic, the toxicity is attributed to the hydrogen ion. These exceptions, as well as a number of others (formic acid, etc.), go to show that the action of substances on organisms cannot be explained on the basis of any one characteristic of the substances. The hydrogen ion is toxic, but acetic acid possesses a toxicity far in excess of that attributable to its hydrogen ion. Cane sugar, regardless of its solubility in oil or in water, can be utilized only by those organisms which contain invertase.

The inhibiting and sometimes fatal effects which the accumulated products of metabolism exert on organisms producing them are matters of general observation. Different organisms vary much, however, in their behavior toward their own products. An interesting illustration of this difference of behavior is brought out by WEHMER[7] in his studies of the effect on *Penicillium variabile* and *Aspergillus niger* of acids accumulating in culture solutions upon which these fungi are growing. The behavior of these two organisms differs widely. In cultures of *Penicillium* on solutions containing ammonium sulphate, WEHMER observed inhibition of growth and ultimately death of the fungus as a result of the accumulation of free acid in the solution. This result does not come about in cultures in which potassium nitrate, ammonium nitrate, ammonium chloride, or ammonium salts of organic acids are the source of nitrogen. In the case of nitrates, both ions are consumed, although here also nitric acid accumulates in the cultures at first. Hydrochloric acid seems to be comparatively harmless to this fungus. In cultures of *Aspergillus niger*, also, acid accumulates in the solution when ammonium salts of inorganic acids are offered as sources of nitrogen, but in the course of a few weeks there is in all cases a diminution of the acidity of the solution. The diminution is most marked with sulphuric acid and least with hydrochloric acid. Growth is not injured by the temporary accumulation of acid, but spore production is inhibited. The acidity is due to the accumulation of inorganic acid and not to the production of organic acids. The author attributes the lowering of the acidity of the cultures to a neutralization of the acid by the products of the protein decomposition in the older parts of the mycelium. Thus the ammonia consumed during the early growth of the culture is finally

---

[7] WEHMER, C., Selbstvergiftung in *Penicillium*-Kulturen als Folge der Stickstoff. Ernährung. Ber. Deutsch. Bot. Gesells. **31**:210–225. 1913.

———, Der Gang der Acidität in Kulturen von *Aspergillus niger* bei wechselnder Stickstoffquelle. Biochem. Zeitschr. **59**:63–76. 1914.

liberated and becomes available for the neutralization of the accumulated acid when through want of a carbon nutrient rapid growth is no longer possible.

KIESEL[8] has examined a large number of acids, mostly organic, and salts of some inorganic acids with reference to their toxicity to *Aspergillus niger*. The numerous data which do not permit of any brief generalizations are, like other data of this kind, of interest more from a toxicological than from a physiological standpoint. The author's conclusion that the toxicity of organic acids cannot be entirely ascribed to the dissociated part of the molecule is in accordance with the findings of other investigators. The mode of action of the dissociated part of the molecule has not thus far been explained. The author's hypothesis, that toxic action which cannot be correlated with chemical properties is associated with the degree of permeability of the protoplasm to the substances exerting such action, is interesting in the light of the researches of MYER and of OVERTON, but it lacks experimental evidence, for it has not been shown on the one hand that toxicity and power to penetrate the protoplast go hand in hand in such cases, and on the other hand it is self-evident that substances which do penetrate the protoplast cannot act as poisons. The author fails to find a regulatory depression of acidity of the medium, as has been reported by some investigators. With regard to the relative toxicity of the chlor-acetic acids, KIESEL'S results harmonize with those of CLARK, who found that the introduction of one or two chlorine atoms into acetic acid increased its toxicity, but the introduction of a third chlorine atom lowered the toxicity.

The problem of antidotal action, or antagonism of one substance toward another, assumes special significance in the study of the toxicity of various substances to fungi, since the toxic substances whose effects are to be studied can rarely be used alone, but must usually be combined with other electrolytes or non-electrolytes requisite for the growth of mycelium and in most cases even for the germination of spores. Several papers dealing with this problem have appeared recently.

From this point of view BOESEKEN and WATERMAN[9] have studied the influence of a series of substances on the toxicity of boracic acid toward *Penicillium glaucum* and *Aspergillus niger*. The substances studied were glycerine, sorbite, dulcite, mannite, arabinose, xylose, glucose, levulose, mannose, rhamnose, galactose, maltose, lactose, raffinose, sucrose, p-oxybenzoic acid, protocatechuic acid, and gallic acid. Definite concentrations (usually 2 per cent) of these substances were used in connection with varying concentrations of the acid. The culture solutions were made with tap water, to which

[8] KIESEL, A., Recherches sur l'action de divers acides et sels acides sur le dévelopement de l'*Aspergillus niger*. Ann. Inst. Pasteur **27**:391–420. 1913.

[9] BOESEKEN, J., and WATERMAN, H. J., Über die wirkung der Borsäure und einiger anderen Verbindungen auf die Entwicklung von *Penicillium glaucum* und *Aspergillus niger*. Fl. Microbiologica **1**:342–358. 1912.

ammonium chloride, potassium di-hydrogen phosphate, and magnesium sulphate had been added. The effect of the acid in combination with the different substances was estimated by the relative development of the cultures. It is noted that the antitoxic action of the substances examined is correlated with the ease with which they combine with the acid, as shown by conductivity changes of the mixtures. Those which combine most readily with boracic acid are also most effective as antidotes to the toxic action of the acid. The antagonistic action of these substances, therefore, is attributed to their power of holding the acid in combination.

Studies of a similar nature have been made by KUNKEL,[10] who investigated the antagonistic action with reference to *Monilia sitophila* between inorganic salts and such substances as peptone, starch, glucose, fructose, and galactose, which are frequent constituents of culture media. These substances all modify the toxicity of salts, but not to the same extent nor in the same order. The author believes that this modification of toxicity may in part be the result of reactions between the salts and the organic substances of the medium,[11] but there appears to be no constant correlation between reduction in the concentration of ions caused by the addition of nutritive substances and the toxicity of the medium. On this account the author believes that the food substances themselves have an influence on the organism by which it is enabled to endure higher concentrations of poisons. This conclusion could hold good only in cases where the toxic effect was entirely due to the ionized portion of the molecule, otherwise there would be no reason for the expectation of a relation between ionic concentration and toxicity. The author finds that spores are capable of remaining alive a long time, two weeks or more, in the presence of toxic substances, provided the concentration is below that at which plasmolysis occurs. It is also noted that slow growth occurs in toxic solutions slightly below the limit concentrations. As a possible explanation of the mode of action of toxic substances in such cases, the author suggests that the effect of the poisons is due to the hindrance of water-absorption by the protoplasm. This hypothesis, it will be remembered, was suggested long ago by LIVINGSTON,[12] who observed a similarity between the action of salts on the cells of the alga *Stigeoclonium* and the withdrawal of water from the cells. In conclusion, the author points out, with justice, that the composition of the medium should be taken into consideration in studies on toxicity of substances to plants.

---

[10] KUNKEL, L. O., The influence of starch, peptone, and sugars on the toxicity of various nitrates to *Monilia sitophila* (Mont.) Sacc. Bull. Torr. Bot. Club **40**:625–639. 1913.

———, Physical and chemical factors influencing the toxicity of inorganic salts to *Monilia sitophila* (Mont.) Sacc. *Ibid.* **41**:265–293. 1914.

[11] See foregoing review.

[12] LIVINGSTON, B. E., Chemical stimulation of a green alga. Bull. Torr. Bot. Club **32**:1–34. 1905.

LE RENARD[13] attempts to establish as a measure of the antitoxic action of a substance the "antitoxic coefficient," which is defined as the ratio between the number of liters containing a gram-molecule of the antitoxic substance in centinormal solution (that is, 100 in the case of monovalent substances) and the number of liters in which a gram-molecule of the toxic substance is dissolved at the limit concentration. The propositions which the author derives from the ratio thus defined, and with whose derivation the first part of the paper is concerned, all follow from the arithmetical relations of the quantities involved in the definition, and like the antitoxic coefficient itself have no physiological significance. In his experiments LE RENARD studied the antagonistic action with reference to *Penicillium glaucum* of formates, acetates, sulphates, and nitrates of potassium, ammonium, and magnesium, and the phosphates of potassium and ammonium in combination with salts (mostly chlorides and nitrates) of the heavy metals. The antitoxic solutions were used in concentrations ranging in a geometrical progression with a ratio of 1/10, usually from N 10^{-2} to N 10^{-5}. The toxic substance was generally used in one or two arbitrarily chosen concentrations. The results show an unusual regularity for biological data. The chief conclusion of the author is that the resistance of *Penicillium* to poisons varies according to the nutritive medium in one of the following ways: (1) the resistance varies, in a simple ratio, inversely as the concentration of the antitoxic substance; (2) the resistance passes a maximum at a comparatively low degree of concentration of the antitoxic substance; or (3) the resistance is not modified. The first part of this conclusion seems scarcely to be borne out by the data, for in nearly all cases where different concentrations of the toxic substances were used the quantities endured by the fungus fell with a diminution of the concentration of the antitoxic substances. It is probable, furthermore, that the use of a greater number of concentrations with smaller intervals between them would have led the author to modify his conclusion as to the simple relation said to exist between the concentration of an antitoxic substance and its effect on the toxicity of another substance. The recent work of SZÜCS[14] has clearly shown that the antagonistic ionic effects do not follow any such simple law of proportionality.

The antagonism between the nitrates of calcium, magnesium, and potassium on the one hand, and nitrates of copper, lead, zinc, aluminum, and nickel on the other hand, with reference to the spores of *Glomerella cingulata*, has been investigated by HAWKINS.[15] The technique employed was similar to

[13] LE RENARD, A., Influence du milieu sur la résistance du Pénicille crustacé aux substances toxiques. Ann. Sci. Nat. Bot. IX. **16**:277–336. 1912.

[14] SZÜCS, J., Experimentelle Beiträge zu einer Theorie der antagonistischen Ionenwirkungen. Jahrb. Wiss. Bot. **51**:85–142. 1913 (rev. in BOT. GAZ. **56**:85. 1913).

[15] HAWKINS, L. A., The influence of calcium, magnesium, and potassium nitrates upon the toxicity of certain heavy metals toward fungus spores. Physiol. Researches **1**:57–92. 1913.

that used and fully described by CLARK. HAWKINS finds in general that the addition of the nitrates of calcium, magnesium, and potassium to solutions of nitrates of copper, lead, or zinc reduces the toxicity of the solutions. With aluminium nitrate no reduction of the toxicity was observed. Nickel nitrate proved toxic only in high concentrations and was not used in combination with the antitoxic nitrates. For combinations of copper nitrate with calcium nitrate it is shown, by considerations based on the mutual influence of salts with a common ion upon the degree of dissociation of each other, and by potentiometer measurements of the concentration of copper ions in the mixture, that neither the reduction of the degree of ionization brought about by the mixing of the salts nor the formation of double salts will account for the lowering of the toxicity of the copper solution by the addition of the calcium salt. For combinations of lead nitrate with nitrates of calcium and magnesium, it is shown that reduction in ionization cannot account for the reduced toxicity of the lead salt. For lead nitrate and zinc nitrate within the limited range of concentrations used (3) there is a constant ratio between the molecular concentration of the toxic salt and that of the antitoxic salt necessary to inhibit the action of increasing concentrations of the toxic salt. For the combination of copper nitrate with calcium nitrate no such constant ratio was evident. The author concludes that the antagonistic action of one salt upon another cannot be attributed, as some investigators have done, either to reduction of the dissociation of the toxic salt or to the formation of undissociated double salts.

Incidental to an investigation, the object of which was to determine the factors inducing the formation of giant cells and mucor yeast by the mucors, RITTER[16] has reported a few experiments on the influence of nitrogenous compounds and sodium chloride on the toxicity of acids. The inhibition of germination of the spores was taken as a criterion of toxicity, although some difficulty was experienced with this test because many of the mucor spores began to form giant cells in concentrations of acid far below the toxic limit. The culture solutions contained, in addition to potassium di-hydrogen phosphate and magnesium sulphate, either peptone or ammonium nitrate and sugar. It was found that malic, citric, tartaric, nitric, and hydrochloric acids were much less toxic in the peptone medium than in the ammonium nitrate medium. The author generalizes from these observations to the effect that the toxicity of organic and inorganic acids is increased by the presence of inorganic nitrogen and depressed by organic nitrogen compounds. The data, it should be remarked, do indeed show an increased toxicity of acids in the presence of ammonium salts as compared with organic nitrogen compounds, but no data showing an absolute increase of toxicity as a result of the addition of ammonium

[16] RITTER, G. C., Die giftige und formative Wirkung der Säuren auf die Mucoraceen und ihre Beziehung zur Mucorhefebildung. Jahrb. Wiss. Bot. **52**:351–403. *pl. 1.* 1913.

salts are presented. For combinations of citric acid and sodium chloride it was found that for a wide range of concentrations, mixtures of these substances were more toxic than either alone. In this case the effect seems to be additive. The concentration of hydrogen ions was found to be the chief factor determining the production of giant cells. The production of mucor yeast, which is in no wise related to the production of giant cells, is determined chiefly by the absence of oxygen in slightly acid media containing sugar.—H. HASSELBRING.

Food substances and growth.—The fact that any given result in plant physiology is usually the result of several factors and is only rarely traceable to one factor alone receives further emphasis in the recent work of BOTTOMLY.[17] Mineral nutrients and toxins have received much attention in the discussion of the causes of soil fertility, and both have been shown to be limiting factors in certain cases. BOTTOMLY'S work emphasizes the idea that the soluble humus of the soil is an essential factor in soil fertility, providing not only food and energy for numerous soil bacteria, but also serving as a source of food for plants. His interpretation of the work reported in this paper is that the chief interest in it centers around the possibility that the nutrition of a plant depends, not only upon the supply of mineral food constituents, but also upon a supply of certain accessory organic food substances, very small amounts of which are sufficient to supply the needs of the plant. He cites literature indicating that other workers have found that soil humates stimulate the action of nitrogen-fixing bacteria and also that they can be readily assimilated by plants.

BOTTOMLY finds that when peat is submitted to the action of certain aerobic soil organisms (he does not say what ones) at 26° C., it decomposes rapidly "and a large amount of the humic acid present is converted into soluble ammonium humate." His use of the terms "humic acid" and "humates" is interesting in the light of the recent statement by SCHREINER[18] that "the compounds . . . . such as humic acid . . . . have absolutely no existence, but are shown to be mixtures of many widely different compounds." In this connection it may be noted that WIELER[19] has taken the view that "humic acids" in soils are inorganic acids resulting, for example, from the action of bases on salts; and that BAUMANN and GULLY[20] have shown that in peat soils the acid properties are due to the colloidal matter of the cell covering the hyaline sphagnum cells.

BOTTOMLY found that bacterized peat, after sterilization, was an excellent medium in which to grow nitrogen-fixing bacteria and apply them to the soil.

---

[17] BOTTOMLY, W. B., The significance of certain food substances for plant growth. Ann. Botany **26**:531–450. 1914.

[18] SCHREINER, O., The organic constituents of soils. Science N.S. **36**:577–587. 1912.

[19] WIELER, A., Pflanzenwachstum und Kalkmangel im Boden. 8vo. pp. vii+235. *figs. 43.* 1912.

[20] BAUMANN and GULLY, quoted in Science N.S. **40**:492. 1914.